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Green economy implementation in Ghana as a road map for a sustainable development drive: A review

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ABSTRACT

Green economy development strategies and the transition from conventional economic development models to green economy has become necessary due to the negative impact of conventional economic development models on the local and global environment. Despite Ghana's effort to transition to green economy that is made evident by the implementation of a number of green economy related policies and strategies, the country is yet to record any significant achievement in that regard. This study therefore used the SWOT analytical tool to access the strengths, weaknesses, opportunities, threats of Ghana's green economy transformation efforts. The results revealed that the country's geographical location, environmental policies, potential for green energy mix, a young and dynamic population, the country's effort to reduce poverty levels and illiteracy rates are the main strengths. However, factors such as weak institutions, inadequate funding for green technologies innovations, inadequate long term policies for green strategies and inadequate political will are some key weaknesses. The study further found commercial interests in driving the development and transfer of green technology, cross-border collaborations and global attention to climate change, local and international support for green economy, awareness and understanding of environmental protection as some of the major opportunities. Inadequate commitment to support technology development and transfer, cost of green technologies, increasing threat of climate change and corruption were identified as threats to Ghana's effort to green its economy. In conclusion, it is imperative that policy makers develop strategies that can help take advantage of the strengths and opportunities while serving as solutions to the weakness and threats. Among other things, it is important for policy makers to prioritize science and technology education to support green economy development.

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Introduction

The exponential increase in human population over the past four decades has occurred at a greater cost to the natural environment. Conventional economic growth models adopted by governments have led to the improvement in living standards, however, this has occurred at the expense of resource use exploitation thereby negatively affacting the natural resource base and causing an increase in greenhouse gas emissions [30,34]. Greenhouse gas emissions over the last four decades have more than doubled [9,47]. In 2010, greenhouse gas emissions consisted of 65% of carbon dioxide emissions usually from fossil fuel and industrial processes. This mainly came from electricity production (25%), Agriculture, Forestry and Other Land Uses (AFOLU) (24%), industry (21%) and transport (14%) [26]. The extinction of natural resources, increasing levels of emissions and the continuous increase in human population will only get worse by the year 2050 if pragmatic steps are not taken to remedy the situation [34].

The 'green economy' concept was officially coined at the Rio+ 20, about two decades after the United Nations (UN) conference on environment and development held in Rio de Janeiro in 1992 formally adopted the sustainable development concept [33]. The aim was to among other things deal with issues pertaining to unsustainable economic development and environmental degradation. The United Nations Environment Programme (UNEP) defines a green economy as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" [58]. Following the 2008 financial crisis, green economy has been mainstreamed into economic debates and it is currently perceived by international organizations and governments as a paradigm shift in contemporary development thinking for the advancement of sustainable economic development [43,62,67]. The concept is based on a low-carbon economy model that aims at achieving low energy consumption and efficiency, pollution and emissions reduction [29], while at the same time helping to improve human life.

Green economy has been widely applied to address issues relating to climate change crises and mitigation [33,62]. South Korea, China and the European Union are fore-runners in the implementation of green economy initiatives over the last decade. For example, between 2009 and 2015, South Korea and China respectively implemented five-year development plans that devotes a huge portion of investments to green initiatives [36]. On the other hand, the European Union has integrated green economy initiatives into the Europe 2020 and the Resource Efficiency Roadmap [37].

In Africa, several existing policies, strategies and plans in some countries have direct links with green economy. For instance, South Africa is well noted for its incorporation of green economy strategies into its national agendas [43]. Likewise, Ghana has over the years formulated policies and developed strategies and plans such as renewable energy policies, low carbon development strategies (LCDs), the national climate change policies, forest and wildlife policies, and the forest investment program (FIP) among others that have direct bearing on green economy transformation. This has largely been influenced by the harsh realities of climate change in recent years due to the increasing rates of environmental degradation that has adversely affected key sectors of the economy such as agriculture, health, energy, and industry [1]. Ghana has also signed a couple of international agreements such as the Kyoto Protocol and the Paris Agreement in response to green economy develpoment. Committing to these agreements, Ghana on the 24th of September 2015, submitted her Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) which takes effect in 2020 [23]. These efforts presents Ghana with a better chance to transition to green economy.

Apart from green economy gaining recognition among world organizations and governments, it has also attracted a lot of attention in the academic world, especially over the last decade. Loiseau et al. [33] among other things developed a framework for green economy that shows the capacity of the green economy concepts, approaches and tools to support the transition towards sustainability. Musango et al. [43] showed the impact of green economy interventions on key sectorial indicators as well as the impact of investments in low carbon development and ecosystem services in South Africa. Smit and Musango [50] explored the nexus between green economy and the informal economy in South Africa and argues that by engaging the informal economy in discussions on the green economy, a more informed policy and planning environment may ensue, resulting in more socially equitable and environmentally sustainable development. Nhamo and Mukonza [44] examined the opportunities available for women in green economy development and environmental sectors in South Africa. They observed that although opportunities are abound for women in the green economy and environmental sectors, it is imperative for policy makers to raise awareness of the available opportunities and interventions to build capacity at project conceptualization and management levels. Mukonza [42] investigated the factors that influence green entrepreneurship activities in South Africa and noted that access to funding, knowledge, competence, information access and government and private sector support are critical to sustaining green entrepreneurship. Other studies have addressed varying issues regarding green economy transition in Ghana in recent years. Some issues addressed in these studies range from the implementation of green information technologies to the adoption of green building technologies (see [5,11,147,16]).

This notwithstanding, no study to the best of knowledge of the authors have assessed the opportunities (internal and external) as well as the challenges (internal and external) that are likely to influence Ghana's green economy transformation. This therefore leaves a research gap in the literature which this study seeks to fill. Also, Despite Ghana's huge potential in terms of the formulation of relevant policies, plans, and strategies as well as the signing of global agreements, with regards to green economy transformation, little has been achieved in terms of actual implementation, which is the most important stage of any transformation agenda. Having said that, this study was carried out to address the issues outlined and to contribute to the extant literature on Ghana. To help address the aforementioned issues, we employ the SWOT analytical approach to assess the factors that are critical for Ghana's green economy transformation. The study based its analysis on

Fig. 1. Diverse perspectives on green economy. Source: UNDESA [57].

existing literature as well as the country's sustainable development policy documents and reports. This study is important because it discusses critical issues that can either positively or negatively affect the country's green economy transformation agenda and suggest potential ways to overcome the negatives whiles taking advantage of the positives.

The rest of this paper is presented in the following order: *"Meaning, benefits and institutions for green economy in Ghana"* presents the meaning and benefits from green economy; and the institutions responsible for a transition to green economy. *"Methodology"* presents the methodology adopted for the study. *"Results and discussion"* presents the results and discussion. *" Conclusions and recommendations"* presents conclusions and recommendations from the study.

Meaning, benefits and institutions for green economy in Ghana

Meaning of green economy

The three dimensions of sustainable development – environmental, social and economic are embedded in the definition for green economy. There are multiple definitions for green economy and green growth. "A green economy is "an economy that provides better quality of life for all within the ecological limits of the planet"[3] (Green economy Coalition). "Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" [46]. The main principles that form the meaning of green economy and green growth are recurrent though their definitions differ [56]. These include environment/ ecology, social and economic. The social aspect of Green economy (GE) or growth relates to improved human well-being and social equity; that is the provision of better quality of life for all. The environmental aspect encompasses the reduction of environmental risks and ecological scarcity. The economic aspect of GE has to do with promoting economic growth and development [57]. Therefore, natural resources and the environment should provide services for human well-being [46,56,58].

Green growth may be similar in concept to green economy since green policies are favorable to economic growth and development [46]. However, green economy concept focuses on finite environmental limits [46]. The term "growth" indicates that countries attach great significance to quantitative expansion of their economies in order to accommodate the ever-rising human population, development goals and poverty reduction [56]. From the foregoing, the concepts of green economy and green growth infer that accomplishing environmental sustainability and economic aspirations/goals are compatible [56].

As a result, green growth is promoted in some regions such as Asia in recent times [58,63]. Institutions like the World Bank, United Nations Economic Commission for Asia and Pacific (UN-ESCAP), Global Green Growth Institute (GGGI), and Organization for Economic Co-operation and Development (OECD) examine and implement green economy together with or under green growth [58,63]. Fig. 1 highlights the diverse perspectives on a green economy where environmental and economic issues are the central focus. The others are ecological, social and human well-being.

[3] This information was accessed on http://www.greeneconomycoalition.org/.

Table 1
Green economy principles.

Type	Principles
Economic	
	1 Recognizes natural capital and values. 2 Creates decent and green jobs. 3 Integrated into economic development and growth models. 4 Promotes resources and energy efficiency. 5 Internalizes externalities.
Environmental	
	1 Protects biodiversity and ecosystem. 2 Invests in and sustains natural capital. 3 Recognizes and respects planetary boundaries and ecological limits. 4 Advances international environmental sustainability goals such as sustainable development goals (SDGs).
Social	
	1 Poverty reduction, well-being, livelihoods, social protection and access to essential services. 2 Socially inclusive, democratic, participatory, accountable, transparent, and stable. 3 Equitable, fair and just.

Source: UNDESA [57].

Table 2
Benefits from green economy.

Economic benefits	Social benefits	Environmental benefits
1 Reduced poverty and inequality. *	1 Reduced poverty and inequality. *	1 Sustainable management of natural assets and resources.
2 Increased economic growth and employment. *	2 Reduced social inequality. *	2 Reduced greenhouse gas and other emissions.
3 Improved training and skills. *	3 Increased employment. *	3 Better adaptation to climate change and resilience to natural disasters.
4 Development of new markets and specialization.	4 Improved training and skills.	4 Improved environmental quality.
5 Increased productivity, and increased commodity and agricultural yields.	5 Better public services.	
6 Improved energy security.	6 Improved health outcomes.	
7 Improved competitiveness and trade balances.		

Source: GIZ [25].
Note: * can be classified under both economic and social.

Principles of green economy and elements of green economy transition

As discussed earlier, the concept of green economy has principles embedded in economic, environmental and social domains [57]. Table 1 summarizes the principles of green economy.

The key elements of green economy transition are: value of natural capital; appropriate economic regulations and incentives; appropriate environmental regulations; sustainable production and consumption patterns; fair distribution of income and social standards; and investment in training and environmental education [69]. The value placed on natural capital suggests that the protection of ecosystems helps in tapping their economic values. This is crucial for especially poor people in developing countries since they heavily depend on natural resources for their livelihoods and are more vulnerable to environmental contamination and degradation [69]. These elements also imply that a green economy seeks to create incentives for economic activities that ensure environmental sustainability and social inclusion [41]. As such it suggests that the core objective of the transition is to aid the transition from the current economic development paradigm, to an economy that generates economic profits while safeguarding environmental sustainability and social inclusion [3,41]. Though green economy emphasizes the environment and economy nexus, the social dimension had been made clear by expanding it to 'inclusive green economy' or 'inclusive green growth' [67].

Benefits from green economy transformation

GIZ [25] have investigated the benefits of green economy transformation and classified them into three: economic, social and environmental benefits (Table 2).

Most green economy initiatives target natural resource use and agriculture, the two most dominant sectors that serves as sources of livelihood for a great majority of rural dwellers in South Saharan Africa (SSA) [25]. This enhances the lives of people in these areas and improve situations; hence, addressing poverty. Green economic development can help increase a country's gross domestic product (GDP), and reduce unemployment leading to an increase in economic growth. This can

be achieved via the improvement in agricultural yield, reduction in energy imports, improvement in the efficient use of land and water, and natural resources as well as the reduction in the economic costs of pollution. Green economy entails adopting new approaches to work which requires the workforce to acquire new skills. For instance, Deutsche Deselschaft fur International Zusammenarbeit, a German company, and Ghana government implemented a training program on 'profitable environmental management' [24]. The training placed more emphasis on safe and efficient resource use to boost the profitability of companies. By concentrating on environmental hazards, companies improve their safety standards, hence attracting new customers [24].

Green economy development makes good use of a country's natural assets sustainably. This could lead to new markets via specialization. An example is Namibia's bio-trade initiative. Green economic development has helped to create niche markets for products and services in areas of energy efficiency, renewable energy production, or sustainable natural resource management, such as low-emitting diode (LED) light bulbs, solar installers and agroforestry [59]. Investments in green development involve developing new technologies and the required expertise that will enhance efficiency and ensure sustainability, which will eventually translate into higher productivity [25]. Energy security is a great issue in SSA as most African countries rely on imported fossil energy. This leads to high energy bills, vulnerability to international price volatility, supply constraints, high greenhouse gas emissions per unit of energy [25]. Green economy initiatives helps to reduce these problems by focusing on efficient measures to cut down energy importation. Green economy focuses on greening energy supply with greater utilization of renewable energy source which can help to improve energy security.

Green economy initiatives directly contribute to health improvements since it supports pollution reduction and improves the natural environment. Examples are sustainable transport policies that lead to a reduction in air pollution [51]. Green economy aims at sustainable management of natural assets and resources such as landscapes, lakes, rivers, mountains and forests to maintain or improve their benefits.

Green economy builds a country's resilience to environmental change or shocks leading to a better adaptation to climate change and natural disasters. This is an area of new product and market development; for instance, through insurance. Ghana has launched an agricultural insurance scheme to protect and provide some level of support to farmers, rural banks and money lenders who invest in drought-index crops [24]. Green economy helps to address the root causes of environmental challenges by establishing systems that deal with environmental degradation via measures such as waste treatment, re-use and recycling. This has enormous health benefits and reduces infrastructure maintenance costs and a general increase in well-being. For instance, bans and penealty charges on plastic bags have reduced plastic waste in Botswana, Cameroon, Kenya, Malawi, Mali, Mauritania, Nigeria, Rwanda, Tanzania, Uganda, and South Africa [25]

Ghana's low carbon growth initiatives and funding

Ghana's economic growth is largely dependent on a rich natural resource base (mining, timber, oil and gas, and agriculture). Even though the country's economic growth figures have improved over the years, this has come at the expense of increased greenhouse gas emissions. That is, greenhouse gas emission over the past few decades has more than doubled the levels recorded in the 1990s [40]. Emissions in Ghana are driven by emissions from the AFOLU sector (53%), followed by the energy sector (25%) of which 39% comes from transport, other fuel combustion (29%), and electricity (19%) [64]. This has contributed massively to climate change effect on the country,thereby, affecting major economic sectors like agriculture and power due to erratic rainfall patterns and prolonged drought in some cases.

With the advent of climate change and its destruction to the natural environment, countries particularly in developing regions like Africa, have shown a significant amount of interest in transitioning from a carbon-intensive economy to a low carbon economy. These low carbon initiatives include but not limited to achieving energy efficiency and the promotion of renewable energy sources, afforestation programmes, improved public transport and waste management [39,70]. These initiatives have largely been undertaken by collaborative efforts between the government of Ghana and donor agencies. Ghana only seriously started exploring low carbon growth strategies in the mid-1990s even though environmental destruction due to climate change on the economy was evident long before this period. Most recent ones, however, include Ghana's three national communications and first biennial report to the UNFCCC, Environmental and Governance Programme (NREG), Reducing Emissions from Deforestation and Forest Degradation (REDD+), Forest Investment Programme (FIP), and Ghana Energy Development and Access Project (GEDAP), among others. Fig. 2 shows the various funding components of Ghana's low carbon growth initiatives, highlighting the most prioritized areas since the mid-1990s Fig. 3.

Institutional players for the transition to green economy in Ghana

The institutional players, their mandates and institutional mechanisms for achieving a transition to green economy in Ghana are outlined in Table 3.

Methodology

SWOT analysis also referred to as situation analysis, is often employed to assess the strengths, weaknesses, opportunities, and threats of national projects and development agendas. The term was adopted by public administration in the eighties after first appearing in business management literature [35]. Since then, it has been used by many academics in

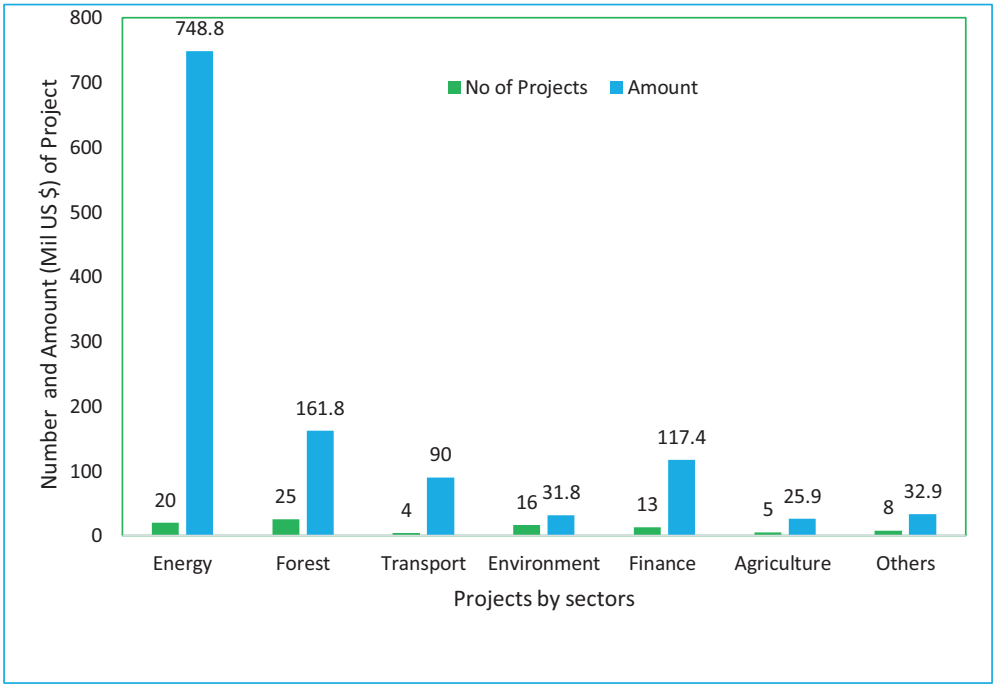

Fig. 2. Ghana's composition of low carbon growth initiatives and funding (in million US$) [39].

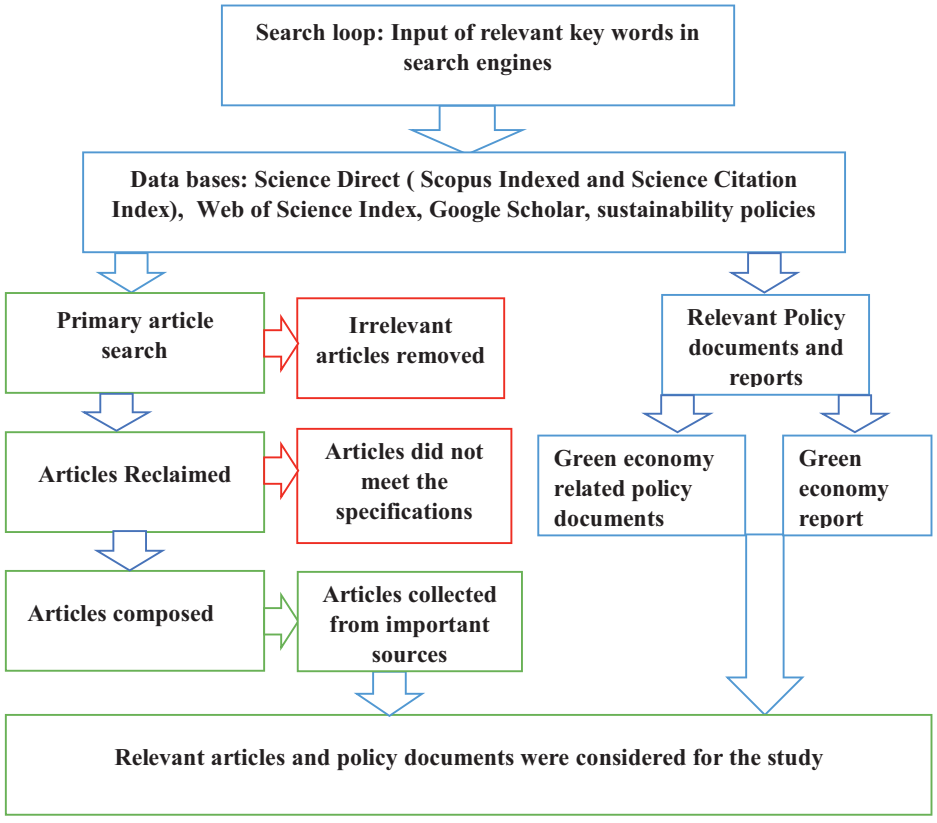

Fig. 3. Proposed framework for the analysis. Source: Authors, 2020.

Table 3
Ghana's institutional players for a transition to green economy.

Institution	Mandate	Institutional mechanism
Ministry of Energy and Petroleum	To monitor and evaluate policies, programmes, and projects within the energy sector.	Ghana Energy Policy, 2010
Energy Commission	To make policy recommendations for the development and utilization of indigenous energy resources including renewable energy.	Renewable Energy Act 2011; Energy Policy; Strategic National Energy Plan 2006 to 2020
Ministry of Environment, Science, Technology and Innovation Environmental Protection Agency	Protection of the environment through policy formulation and initiating activities.	National Environmental Policy; National Climate Change Policy; Environmental Fiscal Reform Policy; National Sanitation Policy National; Sanitation Strategy and Action Plan
Ministry of Local Government and Rural Development	To provide policy formulation, programming, and coordination within the agricultural sector.	Food and Agricultural development policy (FASDEP II); Medium-Term Agricultural Sector Investment Plan (METASIP)
Ministry of Lands and Natural Resources (MLNR); and Forestry Commission (FC)	MLNR oversees the management of Ghana's land, forest, wildlife, and mineral resources through offering policy direction. MLNR works closely with the FC and the Forestry Research Institute of Ghana (FORIG). The FC conserves, protects and manages Ghana's forest and wildlife resources.	Forest and Wildlife Policy; National Land Policy; National Forest Plantation Development Strategy; Reducing emissions from deforestation and forest degradation (REDD-plus) Strategy
Civil society organizations (CSOs) and non-governmental organizations (NGOs)	Conservation International, Ghana; Friends of the Earth; Climate Care; Nature Conservation and Research center; Environmental Applications; and other CSOs/NGOs on environmental issues.	Addressing climate change, poverty eradication, capacity building, and education on the environment.
Environment sector working group	The Institute for Environment and Sanitation Studies at the University of Ghana is an environmentally inclined public institute to assist in meeting Ghana's needs in education, training, and research in the science, policy, and management of environment and sanitation issues.	Climate Change Policy
Energy sector working group	The Public Utilities Regulatory Commission is an independent body in Ghana set up through Act 538 (1997) to regulate the provision of utility services in the water and electricity sectors.	Feed-in-Tariff (FiT)
Agricultural sector working group	Council for Scientific and Industrial Research (CSIR) has the Soil Research Institute which undertakes scientific research for effective management of Ghana soil resources.	FASDEP
National Climate Change Committee	To oversee the draft of the National Climate Change Policy (NCCP), and to review policies for its successful implementation.	Initial communication to the United Nations Framework Convention on Climate Change (UNFCCC); Second National Communication to the UNFCCC; NCCP Framework
Environment and Natural resources Advisory Council	To address all cross-sectoral issues related to environment and natural resources.	Initial communication to the UNFCCC; Second National Communication to the UNFCCC; NCCP Framework
United Nations Environment Programme (UNEP): national cleaner production center, Ghana	To efficiently use Ghana's natural resources by minimizing wastes and emissions.	Functions on sustainable environmentally friendly principles.
Danish International Development Agency (DANIDA): Climate Innovation center, Ghana	To support the growth of Ghana's climate (clean) technology businesses with financing and business incubation services.	Functions on sustainable environmentally friendly principles.

Source: PAGE [48]

many different fields. For example, there have been several evidence of the use of SWOT in fields of energy for sustainable development [2,35], economic systems and climate change [65], low-carbon development pathways [29], waste management [52], and forest sustainability [21].

SWOT analysis can broadly be classified into two components; namely, internal factors consisting of strengths and weaknesses influenced by the internal environment on one hand; and the external factors which consist of opportunities and threats influenced by external environment on the other hand.

Table 4
SWOT analysis quadrant for green economy development.

Internal factors	
Strengths (+)	*Weaknesses (-)*
v **Economic** Ø Geographical location of the country v **Environmental** Ø Potential for green energy mix Ø Policies in support of green economy v **Social** Ø Young and dynamic population Ø Reduction in poverty Significant efforts to reduce illiteracy rate Ø Political Stability	v **Economic** Ø Weak institutions Ø Over-reliance on external support Ø Land use policy and land/ tenure policies Ø Limited number of domestic investors v **Environmental** Ø Lack of adequate local funding for green technology development and innovation v **Social** Ø Inadequacy of Political will
External factors	
Opportunities (+)	*Threats (-)*
v **Economic** Ø Commercial interests in driving the development and transfer of technology Ø Access to global funds on green initiatives v **Environmental** Ø Cross-border collaborations and Global attention to climate Change. v **Social** Ø Local and international support for green economy Ø High awareness and understanding of environmental protection	v **Economic** Ø Inadequate commitment to support technology development and transfer Ø Cost of green technologies v **Environmental** Ø Increasing threat of climate change v **Social** Ø Corruption

Source: Authors, 2020.

For the purpose of this study, we conducted a comprehensive desk review of the relevant literature via two approaches Figure 3 . Namely;

(i) Data gathered from publication databases including articles, and conference proceedings.
(ii) Information gathered from green economy related reports and policies documents such as energy reports, climate change policy documents, forest policy documents, environmental policy documents among others.

A large number of data was collected by the authors for this review work. In order to categorize the data collected, the following framework is carried out:

First, the articles collected related to green economy sources from the Science Direct (Scopus Indexed and Science Citation Index), Web of science citation index, economic sustainability policies, environmental policies, energy policies etc. We also used Google Scholar with the help of carefully coined key words to identify articles of previous authors who conducted related studies. From the green sustainability and related policies, the authors collected data that help to identify green economy related polies in Ghana.

In the second stage, a careful scrutiny of the information collected were carried out that led to the elimination of irrelevant articles. The remaining articles were then reclaimed for the study. Further scrutiny of the reclaimed articled were carried out and articles that were found to fall outside the specifications for the formal analysis were eliminated.

In the final stage, the articles that were deemed relevant to scope of the study were considered.

Results and discussion

This section presents and discusses the SWOT analysis considering the internal and external factors that could either positively or negatively influence Ghana's efforts to transition to a green economy. The adopted SWOT quadrant is presented in Table 4.

Analysis of strengths of green economy in Ghana

Economic

Geographical location of the country. The strategic location of Ghana is such a way that the country is blessed with a lot renewable and other natural resources. Ghana's weather is tropically climatic with significant variations between the north and the south. The unique variation in environmental conditions are highly favorable for the country's agricultural development [6] and natural resource accumulation. The country's location presents it with the opportunity to develop large-scale solar energy sources due to the fact that the entire country basically receives intensive solar radiation all year round. Also

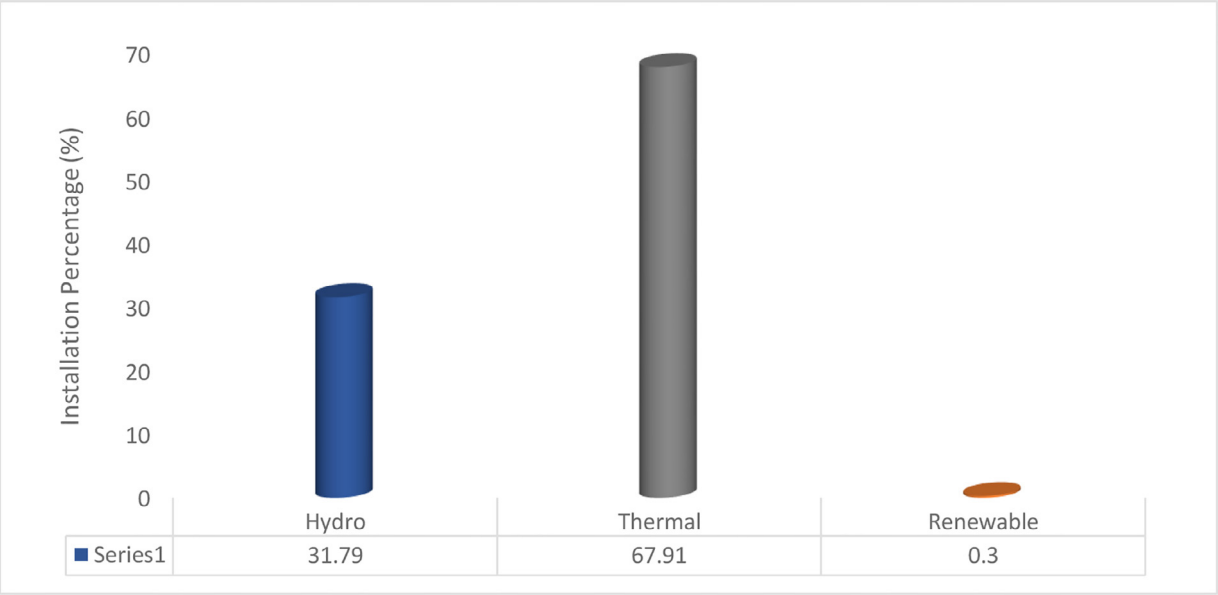

Fig. 4. Ghana's installed energy mix by type. Source: Energy Commission [19].

sections along the coast of Ghana have high wind speed for commercial wind power development [2]. The country is also rich with water bodies that presents another opportunity for the country to scale up the production of hydro power. This is complemented by the availability of a rich natural vegetation which covers vast areas of the country. According to Agyekum et al. [2], the areas covered with rich natural forest has direct nexus with high mean annual rainfall. About 40% (9.17 million ha) of the country's entire land is forest cover,[4] this puts the country in high position relative to biomass energy production. Given that Ghana already exports power to Togo, Benin, and Burkina Faso,[5] the potential to scale up power generation by virtue of the country's location could allow further exports of green power to other neighbouring countries. This could help' improve the country's foreign revenue earnings which can be used for investments in other sectors of the economy.

Environmental

Potential for green energy mix. Renewable energy sources are clean energy sources that are sustainable in nature due to their ability to replenish themselves; and hence, are not depleted. Unlike fossil fuels (coal, oil, and gas), the optimal use of these energy sources have less or no negative impacts on the environment [53,55]. Renewable energy and sustainable development nexus have been found to be positive; thus, providing opportunities in socioeconomic development, mitigation of climate change and energy security [9,10]. Ghana has enormous potential for the development of renewable energy due to the availability of unlimited sources for clean energy production. However, like many developing countries, Ghana is unable to fully exploit this potential. Ghana's potential renewable energy sources include but not limited to solar, wind, hydro, biomass, and wave [38]. The location of the country provides a comparative advantage for solar energy as average solar radiation ranges between 4.0 and 6.5 kWh/m^2/ day with a solar energy potential of 35 EJ [2,38].

The country's demand for energy continues to grow as a result of population growth. As noted by Agyekum et al. [2], between 2000 and 2016, Ghana experienced three power crises due to the country's inability to purchase fuel to run the installed thermal plants. In recent years, however, the purchase of power plants and efforts being made to introduce renewable energy into Ghana's energy mix has helped to stabilize the situation to some extent. The government of Ghana has embarked on a national agenda to increase renewable energy in the national energy generation mix from 42.5 MW in 2015 to 1363.63 MW (with grid connected systems totaling 1094.63 MW) by 2030 [18]. Between 2018 and 2019, renewable energy installation increased from 71.3 MW to 78.6MW respectively [19,20]. This notwithstanding, only 37.5% of the country's energy is renewable (Fig. 4).

Policies in support of green economy. The commitment of a country to effectively and efficiently implement or execute any development agenda without hindrances can be achieved by implementing good policies. National policies are important government mechanisms that stimulate economic development. Environmental policies are measures designed by governments, corporations, public or private organizations to reduce or mitigate the harmful effects of anthropogenic activities on the environment. Over the last two decades, a number of policies have been formulated to reduce the negative ramification

[4] Introduction & Status of The Forestry Sector in Ghana: <http://www.fao.org/3/ab567e/AB567E02.htm>; 2019 [accessed 23 October 2019]
[5] https://www.energymin.gov.gh/sector-overview.

of climate on the environment, which directly or indirectly helps to green Ghana (Table 5). These policies, processes and institutional mechanisms required for green economy transition are divided into development, environment, industrial, energy and water policies. These show Ghana government's commitment to enhancing green economy in the country.

Social

Young and dynamic population. Ghana's population is projected to be around 31 million in 2020 up from the 2010 population of 25 million [22]. The country is home to a large proportion of young adults due to the fact that the majority (over 50%) of the population are under the age of 25 years. This presents a huge potential for technology adoption and investment. Young adults are generally more curious and inclined to try and adopt new technologies [8]. However, fully exploiting this potential to take advantage of current dynamics of green technologies, will require that the country invests in empowering the youth with the necessary skill set for an all-inclusive green economy.

Reduction in poverty levels. Over the years Ghana has chocked significant success in reducing poverty and income inequality among its citizens. A report by Cooke et al. [12] pointed out that between 1992 and 2013, Ghana reduced its poverty estimates from 56.5 to 24.42%, thereby resulting in the country's achievement of the Millennium Development Goal of halving extreme poverty by 2015. It is however, important to note that despite the significant reduction in poverty over the years, income inequality still remains high across regions and between social groups [55]. That notwithstanding, the poverty reduction efforts presents Ghana with a strong potential for its citizens to adopt green economy technologies such as solar energy, domestic waste and water management technologies, especially at the household level.

Significant efforts to reduce illiteracy rate. The best resource a country can ever hope for is a well-educated human resource base. This education enhances the development of knowledge, skills, understanding, values and actions required to create a sustainable world, which ensures environmental protection and conservation, promotes social equity and encourages economic sustainability. Realizing the importance of education to the development of a country, Ghana has over the last four years prioritized the education for all by aggressively implementing a free secondary school education system. This national policy as the name suggests aims at providing free secondary education to all students of school going age who qualify to pursue secondary school education.

Political Stability. After gaining independence in 1957 and transitioning to democratic governance in 1992, Ghana has been considered one of the most stable countries in the world. Significant effort has been made to consolidate the country's status as the "beacon of hope" in Africa in terms of advancement in democracy. This provides a peaceful working environment for both local and foreign investors while at the same time serving as the gateway into the west African sub region [12,45].

Analysis of weaknesses of green economy in Ghana

Economic

Weak institutions. The development of green technologies and transfer require extensive research and commitment from all stakeholders including higher educational institutions, research institutions, private sector, financial sector, policy-making bodies, and government as a whole [60]. Ghana has over the years invested in establishing institutions to deal with environmental issues. This notwithstanding, these institutions remain weak due to the lack of innovation, poor or no collaboration among institutions, and poor infrastructure and resources for research and development. For this reason, the country is unable to produce good, reliable, and up-to-date data on environmental issues that can help in the understanding of how the country can best be transformed into a green economy. For example, after submitting the 2014 National Inventory Report (NIR) to the United Nations Convention Framework Convention on Climate Change(UNFCCC), Ghana has failed to update her data on greenhouse gas emissions. Between 2012 and 2019, no data exist on the country's greenhouse gas emissions, and this poses a serious challenge to fully understanding the country's environmental challenges.

Over-reliance on external support. The over-dependence on external support coupled with low domestic savings for financing development projects poses a serious challenge for green economy transformation [61]. (As at December 2019, Ghana's dept stock was 63% of GDP, an increase of about 5.4% from figures recorded in 2018 (Ministry of Finance, [72]). An unofficial IMF report projects Ghana's dept to GDP to rise to about 74.7% of GDP by 2021.[6] The rising debt possess a threat to both the fiscal and monetary economy, particularly revenue mobilization, exchange rate and inflation. This also effects the financing of green projects and initiatives, especially because Ghana is predominantly an import-led economy.

[6] https://www.myjoyonline.com/business/ghanas-debt-to-gdp-ratio-to-hit-76-7-in-2020-imf/.

Table 5
Policies in support of green economy in Ghana.

Policy	Brief description
A. Economic policies	
Ghana Shared Growth and Development Agenda (GSGDA I, 2010–2013)	GSGDA I aimed at enhancing natural resource development, energy for accelerated employment creation and income generation for poverty reduction, among others.
Ghana Shared Growth and Development Agenda (GSGDA II, 2014–2017)	GSGDA II aims at "leveraging Ghana's natural resources endowments, agricultural potentials and the human resource base for accelerated economic growth and job creation through value addition." Green initiatives in the GSGDA I and II policies are government efforts to accelerate agricultural transformation and sustainable natural resource management in Ghana.
National Energy Policy (2009) and National Energy Strategy (2010)	These policies aim to develop an energy economy that guarantees a reliable supply of high-quality energy services for all sectors of Ghana. The policy covers areas such as power; renewable energy; petroleum; waste-to-energy; energy and gender; energy efficiency and conservation; energy and environment; and managing the future of the energy sector.
Renewable Energy Act (Act 832) (2013)	The Renewable Energy Act (Act 832) is a legislative instrument for providing an enabling environment for the "development, utilization, sustainability and adequate supply of renewable energy for the generation of heat and power" in Ghana. The act promotes the use of renewable energy, improvement of access to electricity, diversification of energy supplies to safeguard energy security. The Act has established the Feed-in-Tariff law in Ghana with these components: renewable energy purchase obligation; Feed-in-Tariff rates; and a connection to transmission and distribution systems.
Industrial Policy	The Industrial Policy of Ghana aims at increasing competitiveness and enhancing industrial production with increased employment and prosperity for all Ghanaians. The policy outlines pro-low carbon development measures such as regulating the importation of overaged machinery; and the deployment of state-of-the-art plants and machinery. On water and electricity efficiency and management in industries, the policy targets energy and water efficiency and conservation programmes. To ensure environmental sustainability, the policy outlined green initiatives like the adoption of clean production technologies and improved manufacturing processes; implementation of programmes for promoting the efficient use of raw materials, energy and water in industries; and strengthening the capacity of regulatory bodies for enforcing environmental regulations.
National Employment Policy (2012)	The National Employment Policy of Ghana aims at tackling employment-related challenges confronting the labor market. This policy outlines a set of strategies that seek to sustainably reform and improve structures, systems responsible for the effective management of the labor market. e.g. promoting on- and off-farm rural employment via agricultural modernization which in effect have ripple effects on improving human wellbeing and environmental quality.
Ghana National Export Strategy for the Non-traditional Sector (2012)	This policy aims at contributing to developing the "potential of the non-traditional export sector to enable it to make maximum contribution to GDP growth and national development." The policy seeks to help establish a nexus between the various sectors of the economy and human wellbeing (i.e. job creation and poverty reduction) through a sustainable consolidation of the country's middle income status.
Strategic National Energy Plan	Strategic National Energy Plan (SNEP) for the period 2006 – 2020 seeks to contribute to the development of a sound energy market that would provide sufficient, viable and efficient energy services for Ghana's economic development through the formulation of a comprehensive strategy that identifies the optimal path for the development, utilization and efficient management of energy resources available to the country.
B. Environmental policies	
National Climate Change Policy (NCCP, 2013)	The National Climate Change Policy (NCCP) (2013) of Ghana seeks to "ensure a climate-resilient and climate-compatible economy while achieving sustainable development through equitable low-carbon economic growth." Government desires to address all effects of climate change on the economy through effective adaptation, and mitigation strategies. These focus on energy and infrastructure; natural resources and management; agriculture and food security; and disaster preparedness and response. The policy targets the agricultural, forestry and energy sectors since they are vulnerable to climate change. The policy has the following guiding principles: polluter pays principle which disincentivizes uncontrolled discharges of emissions; the principle of required action; the principle of improving equity and gender sensitivity; the principle of delivering the greatest common good to society when prioritizing conflicting responses to climate change; the principle of solidarity and expressing profound human response for common problems related to climate change.
National Climate Change Master Plan-2015	The purpose of the national climate change master plan is to put in place robust measures needed to address most, if not all, of the challenges posed by climate change and climate vulnerability. It is important for me that this strategy has been through a very participatory process extensively conducted across the country.
Ghana Environmental Fiscal Reform Policy (2013)	The policy aims at sustainable development, environmental protection, climate change and green principles in Ghana. Thus, it addresses waste management; deforestation and biodiversity; land degradation through mining activities; vehicular, industrial and energy emissions.
National Climate Change Adaptation Strategy (NCCAS)	The objectives of the strategy are to: improve societal awareness and preparedness for future climate change; enhance mainstreaming of climate change into national development to reduce climate change risks; increase the robustness of infrastructure development and long-term investments; enhance the adaptability of vulnerable ecological and social systems; foster competitiveness and promote technological innovation.
Sanitation Policy (2007)	The revised Sanitation Policy (2010) of Ghana aims at contributing to the development and maintenance of a clean, safe and pleasant physical and natural environment in order to promote sociocultural, economic and physical well-being in Ghana. The sanitation policy is built on polluter pays and precautionary principles.

(*continued on next page*)

Table 5 (*continued*)

Policy	Brief description
Forest Development Master Plan (1996–2020).	This policy aims at "conservation and sustainable development of the nation's forest and wildlife resources for maintenance of environmental quality and perpetual flow of optimum benefits to all segments of society" and has the following objectives: Management and enhancement of Ghana's permanent estate of forest and wildlife resources for preservation of vital soil and water resources, conservation of biological diversity and the environment and sustainable production of domestic and commercial produce; Promotion of viable and efficient forest-based industries, particularly in secondary and tertiary processing, so as to fully utilize timber and other products from forests and wildlife resources and satisfy domestic and international demand for completely-priced products; Promotion of public awareness and involvement of rural people in forestry and wildlife conservation so as to maintain life-sustaining systems, preserve scenic areas and enhance the potential of recreation, tourism and income-generating opportunities; Promotion of research-based and technology-led forestry and wildlife management, utilization and development to ensure resource sustainability, socioeconomic growth and environmental stability; Development of effective capacity and capability at national, regional and district levels for sustainable management of forest and wildlife resources.
The Forest Plantation Development Strategy (GFPS) (2016–2040)	The goal of GFPS is to achieve sustainable supply of planted forest goods and services to deliver a range of economic, social and environmental benefits over and beyond the duration of the duration of the strategy
The REDD+ Strategy (2016–2035)	"Ghana's Vision for REDD+ is to significantly reduce emissions from deforestation and forest degradation over the next twenty years, whilst at the same time addressing threats that undermine ecosystem services and environmental integrity so as to maximize the co-benefits of the forests."
National Environmental Policy (2012)	The policy describes the Government's focus in the medium term on shifting the economy from the current factor-driven one to an efficiency-driven one. "This will be achieved by anchoring industrial development on the conversion of Ghana's natural resources into value-added products with emphasis on agro-based manufacturing, down-stream oil and gas and mineral processing and manufacturing, tourism, and creative arts." The policy reconfirms the government's commitment to the polluter pays principle
Ghana's National Determined Contributions (GH–NDCs)	The GH–NDCs highlights Ghana's mitigation and adaptation commitments within the Paris Agreement. It provides strategic direction and co-ordinate issues of climate change mitigation and adaptation
C. Social policies	
National Water Policy (NWP) (2007)	The Ghana National Water Policy (NWP) aims at "achieving sustainable development, management and use of Ghana's water resources to improve health and livelihoods, reduce vulnerability while assuring good governance for present and future generation." The policy has strategies to attain some objectives under water resource management, urban water supply, and community water and sanitation. .
Ghana Shared Growth and Development Agenda (GSGDA I, 2010–2013)	GSGDA I aimed at enhancing natural resource development, energy for accelerated employment creation and income generation for poverty reduction, among others.
Ghana Shared Growth and Development Agenda (GSGDA II, 2014–2017)	One of the objectives of the Ghana Shared Growth and Development Agenda (GSGDA) II (2014–2017) is to produce a knowledgeable, well-trained, disciplined, highly productive, and healthy population with the capacity to drive and sustain the socioeconomic transformation of the country over the long term.
National Science, Technology and Innovation Policy	The Policy aims to ensure that science and technology drives all sectors of the economy to accelerate the promotion of innovation through the development and utilization of modern scientific and technological capabilities to provide the basic needs of the citizenry and to compete ably in the global market. This includes moving away from old technologies to newer and more knowledge-intensive technologies.

Source: PAGE [48,49]

Land use policy and land/tree tenure policies. One major issue that is likely to hinder the sustainable management of land in Ghana and for that matter green economy transfortion is the discrepancies between land and tree tenure. Damnyag et al. [13] observed that a vast majority (78%) of Ghana's total land area is owned along ethno-tribal and family lines, with traditional authorities as managers in their capacity as trustees. Land ownership in Ghana can be classified into three forms, namely: customary, public and the vested lands [31,71]. The current system of land ownership in the country poses a huge threat to the development of renewable energy, particularly technologies such as solar PV, concentrated solar power and wind energy which requires large and accessible area of land for the development of commercial power plants [4]. Additionally, the separation of land tenure from tree tenure particularly in the northern part of the country, affects land users and hence is responsible for the depletion of land resources and deforestation in the country [13].

Limited number of domestic investors. A number of studies have discussed the important role investors play in the financing, development and distribution of green technologies and initiatives [46]. However, in the work of PAGE[49], they observed

that there is a limited number of local investors in green financing in Ghana. They further noted that even though local investors have the capacity to promote green financing, little has been done to harness this potential.

Environmental

Lack of adequate local funding for green technology development and innovation. One critical component of green technology development and innovation is its perceived associated cost, especially in the short run. Even though green technologies are believed to be cost-effective in the long-run, local investors are sceptical [49]. This probably is due to the lack of awareness of the real cost and benefits of green technologies among local investors and policymakers. Also, issues with data unavailability and capacity to access potential green investment risks have been the bane of green financing in Ghana. Given that the private sector is a major player in green technology development and innovations, it is imperative that adequate capacity is provided to enhance the assessment of the risks associated with green investments.

Social

Inadequacy of political will. As discussed earlier, Ghana has formulated some of the best environmental policies in the West African sub-region, yet the country still struggles with for example the negative ramifications of climate change. This is largely due to the lack of commitments by successive governments to implement such policies. The will and commitment to adequately finance green initiatives have been lacking. In instances where government has expressed the commitment via the signing of protocols in support of green economy development and implementing the relevant policies, the challenge has always been the actual implementation. It is imperative to point out that to successfully adopt green economy initiatives, government's commitment must go beyond merely signing international agreements and treaties and developing policies to actual implementation. Achieving this will require complementing the existing efforts with the right funding and technology development.

Analysis of opportunities for green economy in Ghana

Economic

Commercial interests in driving the development and transfer of technology. Ghana, like most African countries, is heavily endowed with natural resources which have formed the main economic backbone of the country for decades. However, the depletion of these resources in recent years has necessitated the diversification of the country's economic activities. This has helped the country to open up to cross-border trade. As a result, Ghana became the most attractive destination for Foreign Direct Investment (FDI) in the West African region overtaking Nigeria in the process [68]. For instance, in 2018, Ghana attracted about US$ 3.5 billion of FDI [68]. With the emergence of green technology development and Ghana's effort to transition to green economy development, the country presents a viable destination for green technology investment and the creation of a niche market for such technologies. Furthermore, the increasing demand for green products and services among Ghanaians provides a huge avenue for green investments [49].

Access to global funds on green initiatives. With increasing threat of global climate change and the desire to remedy the situation, several efforts have been made at the global level to address same. One important factor that has been identified to play a major role in dealing with climate change and environmental degradation is funding [55]. Ghana's efforts to green its economy is boosted by its ability to access global climate funds such as Green Climate Fund (GCF), the Global Environmental Facility [49] among others as well as accessing funds through the REDD+. These funds are made available to help developing countries in the efforts to transition to green economies.

Environmental

Cross border collaborations and global attention to climate change. With the advent of the severe negative impact of climate change on the global environment, the need for the development and implementation of green technologies and strategies has become a major global concern. Governments all over the globe are making huge investments to find sustainable ways to mitigate climate change effects. This has created a broader scope for discussions among global stakeholders to find lasting solutions that will reduce the global impact of climate change. For instance, upon realizing the importance of sustainable development which was marginally addressed by the Millennium Development Goals (MGDs), the United Nations (UN) adopted a more aggressive approach which led to the formation of the 2030 agender for Sustainable Development Goals (SDGs). Ghana, as a member state of the UN, has adopted and incorporated the SDGs into her national polices. According to Agyekum et al.[2], Ghana and Russia in 2015 signed a Memorandum of Understanding (MoU) to develop a nuclear power plant in Ghana. This forms part of the country's agender to transition from non-renewable power sources to renewable energies.

Social

Local and international support for green economy. Being aware of the sustainable economic, environmental and social benefits associated with green economy (see Table 2), the government of Ghana is committed to mainstreaming programmes aimed at enhancing green economy development of the country. Examples are renewable energy and afforestation programmes/policies in the country. Furthermore, due to its numerous benefits, green economy has gained huge support from

civil society organizations (CSOs) in Ghana, regional/international development partners/organizations such as Economic Community of West African States (ECOWAS), African Union (AU), and the United Nations (UN), among others. These agencies create awareness, provide financial support, and assist government in the implementation of green economy policies in various ways.

High awareness and understanding of environmental protection among people. There is high awareness of the benefits from environmental sustainability/protection in the country. For instance, local Ghanaian communities are highly aware of the need for afforestation, sustainable forest management, conservation agriculture, and other forms of ensuring green economy, in the advent of increasing risks of climate change. Thus, traditional authorities take measures to safeguard biodiversity and the ecosystem of their respective localities. These lead to sustainable use of terrestrial ecosystems by rural folks, and subsequently reduce desertification and loss of biodiversity.

Analysis of threats to green economy in Ghana

Economic

Inadequate commitment to support technology development and transfer. Development and implementation of green economy strategies in developing countries cannot be achieved without the commitment and support from the international community. However, the commitment to implement international strategies that support the development and transfer of green technologies in developing countries like Ghana appear to be lacking. As observed by ECA [17], it took over a decade and a half for the UN to establish a technology mechanism under the UNFCCC at the request of developing countries. This lack of commitment derails efforts by these countries to effectively establish and implement green technology mechanisms. Also, the non-binding nature of most international declarations and provisions relevant to international support for technology development and transfer translates into developing countries not feeling obliged to meet these commitment [17].

Cost of green technologies. Ghana's quest to transition to a green economy is hindered by the perceived cost of these technologies. Even though green technologies provide long term cost-effectiveness, the initial cost required for implementation can be very expensive. For instance, the cost of a hybrid vehicle is more than double that of a normal vehicle that runs entirely on fuel [27]. As a result of the high cost, the average person is unable to afford and hence affects the all-inclusive nature of green technologies. Currently, the development and transfer of green technologies are concentrated in the western world and are usually motivated by profits leading to high costs which are not affordable by developing countries. It is therefore important that the social considerations in business goals in the development of these technologies should supersede that of profits so as to help achieve an all-inclusive green economy both at the local and global levels.

Environmental

Increasing threat of climate change. The adverse ramification of climate change and its economic impact on developing countries like Ghana, has attracted a lot of concern from stakeholders [28]. Climate change impact on the Ghanaian economy over the past years has worsened [66]. Fluctuations in climate variables such as rainfall and high temperatures in recent years has led to a reduction in productivity levels due to the interference with regular power supply in Ghana. Renewable energy technologies that are dependent on stable weather conditions are likely to be most affected by the negative effect of climate change as they have consequence on the reliability and performance of the energy system [4]. Weather conditions can also affect transmission lines and other equipment along the value chain [71]

Social

Corruption. The issue of corruption has been a major course of worry for many African countries of which Ghana is no exception. According to Transparency International [54], Ghana performed poorly on the Corruption Perception Index (CPI) dropping from 48 in 2014 to 41 in 2019 and ranked 80th out of 180 countries. Issues of corruption goes beyond government officials to the ordinary person on the streets who pays bribe to get a favor. The net effect of corruption could go as far as increasing the net cost of adopting a green technology which would imply excluding majority of Ghanaians. Studies have found a direct correlation between corruption and the cost of establishing a power plant [15,32].

Conclusions and recommendations

Green economy transformation has the potential to offset environmental, economic and social risks and sustainably improve all sectors of the economy. Such transformation is relevant for a country like Ghana which largely depends on the natural environment for sustenance, and thus highly vulnerable to the ramifications of changing climate. With Ghana's standing as the "beacon of hope" for Africa, it is imperative for the country to adopt more sustainable ways to achieve economic, social, and environmental improvement. The main aim of the paper is, therefore, to analyze Ghana's preparedness to green its economy by employing the SWOT analytical tool.

The results from the study showed that Ghana has huge potentials with respect to its ability to green the economy. It is therefore important for policy makers to put in place strategies that can help take advantage of the strengths and opportunities while serving as solution to the weaknesses and threats. The geography of the country, energy mix potential, policies

in support of green economy, a reduction in poverty levels, and a young and dynamic population are the main strengths for Ghana. The country's location in the tropics for example presents a number of advantages in terms of the number of renewable energy sources available to her, which is a critical component of green economy transformation. These notwithstanding, a number of weaknesses may threaten the country's ability to take full advantage of the strengths. Among the identified weaknesses are institutional weakness, lack of sufficient funding, over-reliance on external partners, overdependence on the natural environment, inadequacy of political will etc. Given that these weaknesses have the potential to nullify the strengths identified in the study it is important to take the necessary steps to effectively reduce or eradicate these barriers. The opportunities available for Ghana's economy abound. However, the most critical as identified in the study include the growing awareness and understanding of environmental protection, cross-border collaborations and global attention to climate change, commercial interests in driving the development and transfer of green technologies, reduction and in poverty and effort to reduce illiteracy rate in the country. These opportunities coupled with the strengths presents Ghana with a huge advantage to transition to a green economy. This notwithstanding, Ghana needs to overcome certain threats such as the perception of corruption and its impact on green technology development and transfer. The impact of corruption could have a ripple effect on the cost of green technologies as cost may be inflated beyond the normal. Therefore, to partly deal with the cost of green technologies, it is important to strengthen the country's laws on corruption to serve as a deterrent to those likely to be found culpable especially in the award of contracts for green technology development and transfer. Also, a strong commitment must be made especially by government and other policy makers to support green economy development by paying more attention to science and technology education in the country. In addition, more efforts must be made by government and policy makers to go beyond just signing international agreements and treaties that support green economy transformation to actual implementation.

It worth noting that although the study focused on the special case of Ghana, the findings may not significantly differ from similar situations in other developing countries especially those in Africa. As such the recommendations in this study may apply to other African countries that seek to develop green economy initiatives.

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References

[1] A. Adu-Boateng, Barriers to climate change policy responses for urban areas: a study of Tamale Metropolitan Assembly, Ghana, Curr. Opin. Environ. Sustain. 13 (2015) 49–57.
[2] E.B. Agyekum, M.N.S. Ansah, B.K. Afornu, Nuclear energy for sustainable development: SWOT analysis on Ghana's nuclear agenda, Energy Rep. 6 (2020) 107–115, doi:10.1016/j.egyr.2019.11.163.
[3] C.A. Agyekum, H. Haifeng, A. Ayeiwaa, Ghana's effort towards the emergence of green economy, Int. J. Ecosyst. 6 (2) (2016) 43–46.
[4] E.B. Agyekum, Energy poverty in energy rich Ghana: a SWOT analytical approach for the development of Ghana's renewable energy, Sustain. Energy Technol. Assess. 40 (2020) 100760.
[5] A. Ahenkan, J. Osei, E.H. Owusu, Mainstreaming green economy: an assessment of private sector led initiatives in climate change adaptation in Ghana, J. Sustain. Dev. 11 (2) (2018) 77–87, doi:10.5539/jsd.v11n2p77.
[6] E.B. Ali, E.B. Agyekum, P. Adadi, Agriculture for sustainable development: a SWOT-AHP assessment of Ghana's planting for food and jobs initiative, Sustainability 13 (2) (2021) 628, doi:10.3390/su13020628.
[7] J. Amankwah-Amoah, D. Sarpong, Historical pathways to a green economy: the evolution and scaling-up of solar PV in Ghana, 1980–2010, Technol. Forecast. Soc. Change 102 (2016) 90–101.
[8] B. Amfo, E.B. Ali, Climate change coping and adaptation strategies: how do cocoa farmers in Ghana diversify farm income? Forest Policy Econ. 119 (2020) 102265, doi:10.1016/j.forpol.2020.102265.
[9] S. Asumadu-Sarkodie, P.A. Owusu, A review of Ghana's energy sector national energy statistics and policy framework, Cogent Eng. 14 (1) (2016), doi:10.1080/23311916.2016.1155274.
[10] S. Asumadu-Sarkodie, P.A. Owusu, Carbon dioxide emissions, GDP, energy use and population growth: a multivariate and causality analysis for Ghana, 1971-2013, Environ. Sci. Pollut. Res. Int. (2016), doi:10.1007/s11356-016-6511-x.
[11] C. Bai, S. Kusi-Sarpong, J. Sarkis, An implementation path for green information technology systems in the Ghanaian mining industry, J. Clean. Prod. 164 (2017) 1105–1123.
[12] Cooke, E., Sarah, H., McKay, A., (2016). The Ghana Poverty and Inequality Report: Using the 6th Ghana Living Standards Survey. https://www.unicef.org/ghana/media/531/file/The%20Ghana%20Poverty%20and%20Inequality%20Report.pdf. (Accessed on 2.11.2020).
[13] L. Damnyag, O. Saastamoinen, M. Appiah, A. Pappinen, Role of tenure insecurity in deforestation in Ghana's high forest zone, J. Forest Policy Econ. 14 (1) (2011) 90–98 Doi:, doi:10.1016/j.forpol.2011.08.006.
[14] A. Darko, A.P.C. Chan, Y. Yang, M. Shan, B.J. He, Z. Gou, Influences of barriers, drivers, and promotion strategies on green building technologies adoption in developing countries: the Ghanaian case, J. Clean. Prod. 200 (2018) 687–703.
[15] K.B. Debnath, M. Mourshed, Corruption significantly increases the capital cost of power plants in developing contexts, Front. Energy Res. 6 (8) (2018), doi:10.3389/fenrg.2018.00008.
[16] D.B. Dovie, A communication framework for climatic risk and enhanced green growth in the eastern coast of Ghana, Land Use Policy 62 (2017) 326–336.
[17] Economic Commission for Africa (ECA). Enabling measures for an inclusive green economy in Africa. Retrieved from https://www.uneca.org/sites/default/files/uploaded-documents/Natural_Resource_Management/enabling-measures-report-final-draft-pds.pdf. (Accessed on 04.02. 2020).
[18] Energy Commission (2019). Ghana renewable energy master plan. Retrieved from http://www.energycom.gov.gh/files/Renewable-Energy-Masterplan-February-2019.pdf. (Assessed on 18.02.2021).

[19] Energy Commission (2020). 2020 energy (Supply And Demand) outlook for Ghana. Retrieved from http://www.energycom.gov.gh/planning/data-center/energy-outlook-for-ghana. (Assessed on 21.02. 2020).
[20] Energy Commission of Ghana (2018). Energy supply and demand outlook for Ghana. http://www.energycom.gov.gh/planning/data-center/energy-outlook-for-ghana. (Accessed on 05.01.2020).
[21] P.M. Falcone, A. Tani, V.E. Tartiu, C. Imbriani, Towards a sustainable forest-based bioeconomy in Italy: findings from a SWOT analysis, Forest Policy Econ. 110 (2019) 101910, doi:10.1016/j.forpol.2019.04.014.
[22] Ghana Statistical Service (2014). 2010 population and housing census report: population projects/prospects. Accra, Ghana.
[23] GH-INDC (2015). Ghana's Intended Nationally Determined Contribution (INDC) and Accompanying Explanatory Note. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Ghana%20First/GH_INDC_2392015.pdf. (Assessed on 06.11.2020).
[24] GIZ (2012). Green economy in sub-Saharan Africa – lessons from Benin, Ethiopia, Ghana, Namibia and Nigeria. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Bonn, Germany, p. 50.
[25] GIZ, in: Benefits of a Green economy Transformation in Sub-Saharan Africa, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Bonn, Germany, 2015, p. 40. p..
[26] IPCC (Intergovernmental Panel on Climate Change)Climate Change 2014 Mitigation of Climate Change, Working Group III Contribution to the Fifth Assessment Report of the IPCC, IPCC, Geneva, Switzerland, 2014 Retried from https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_full.pdf.
[27] A. Iravani, M.H. Akbari, M. Zohoori, Advantages and disadvantages of green technology; goals, challenges and strengths, Int. J. Sci. Eng. Appl. 6 (9) (2017) 272–284.
[28] H. Irshad, Local Food-A Rural Opportunity. Agricultural and Rural Development, 2010 Government of Alberta.
[29] X. Jin, Guang Yuan low-carbon development Path based on SWOT analysis, J. Sustain. Dev. 5 (8) (2012) 78–83, doi:10.5539/jsd.v5n8p78.
[30] S.M. Khoshnava, R. Rostami, R.M. Zin, H. Kamyab, M.Z.A. Majid, A. Yousefpour, A Mardani, Green efforts to link the economy and infrastructure strategies in the context of sustainable development, Energy 193 (2019) 116759, doi:10.1016/j.energy.2019.116759.
[31] I. Lambrecht, S. Asare, The complexity of local tenure systems: a smallholders' perspective on tenure in Ghana, Land Use policy 15 (58) (2016) 251–263 2016 Dec.
[32] G. Locatelli, G. Mariani, T. Sainati, M. Greco, Corruption in public projects and megaprojects: there is an elephant in the room, Int. J. Proj. Manag. 35 (2017) 252–268, doi:10.1016/j.ijproman.2016.09.010.
[33] E. Loiseau, L. Saikku, R. Antikainen, N. Droste, B. Hansjürgens, K. Pitkänen, M. Thomsen, Green economy and related concepts: an overview, J. Clean Prod. 139 (2016) 361–371.
[34] A. Mardani, D. Streimikiene, M. Nilashi, D.A. Aranda, N. Loganathan, A. Jusoh, Energy consumption, economic growth, and CO_2 emissions in G20 countries: application of adaptive neuro-fuzzy inference system, Energies 11 (10) (2018), doi:10.3390/en11102771.
[35] N. Markovska, V. Taseska, J. Pop-Jordanov, SWOT analyses of the national energy sector for sustainable energy development, Energy 34 (6) (2009) 752–756, doi:10.1016/j.energy.2009.02.006.
[36] J.A. Mathews, Green growth strategies-Korean initiatives, Futures 44 (2012) 761e769, doi:10.1016/j.futures.2012.06.002.
[37] Mazza, L., ten Brink, P., 2012. Green economy in the European Union. Supporting Briefing, with Support from Fedrigio-fazio, D. UNEP, IIEP & Globe European Union e EU. Available at: http://www.unep.org/pdf/Supporting_Brief_2012.pdf.
[38] K. Mensah, S. Boahen, K. Owura-Amoabeng, Renewable energy situation in Ghana: review and recommendations for Ghana's energy crises, in: Proceedings of the 1st GHASKA Innovation Conference (GIC) on May 5th, 2017, Suwon, Korea, 2017.
[39] MESTI (Ministry of Environment, Science, Technology and Innovation)Ghana's Low Carbon Development Strategy (LCDS): Facilitation, Implementation and Readiness for Mitigation (FIRM), MESTI, Accra, Ghana, 2016.
[40] MESTI and EPA (2015). National greenhouse gas inventory report, 2014 National Carbon Accounting. Ministry of Environment, Science, Technology and Innovation (MESTI) and Environmental Protection Agency (EPA), Accra, Ghana. Available at: https://unfccc.int/resource/docs/natc/ghanir.pdf.
[41] A. Mourougane, Phasing out energy subsidies in Indonesia, Organization for Economic Co-Operation and Development (OECD) Economics Department Working Papers, Number 808, OECD, Paris, France, 2010 p. 15.
[42] C. Mukonza, An Analysis of Factors Influencing Green Entrepreneurship Activities in South Africa, in: C. Atewamba, D. Yong Ngondjeb (Eds.), Inclusive Green Growth. Advances in African Economic, Social and Political Development, Springer, Cham, 2020, doi:10.1007/978-3-030-44180-7_3.
[43] J.K. Musango, A.C. Brent, A.M. Bassi, Modelling the transition towards a green economy in South Africa, Technol. Forecast. Soc. Change 87 (2014) 257–273.
[44] G. Nhamo, C. Mukonza, Opportunities for women in the green economy and environmental sectors, Sustain. Dev. 28 (2020) 823–832 2020, doi:10.1002/sd.2033.
[45] F. Obeng-Odoom, Global political economy and Frontier economies in Africa: implications from oil and gas industry in Ghana, Energy Resour. Soc. Sci. 10 (2015) 41–56.
[46] OECD (Organisation for Economic Co-operation and Development), in: Towards Green Growth, OECD, Paris, France, 2011, p. 9.
[47] P.A. Owusu, S. Asumadu-sarkodie, A review of renewable energy sources, sustainability issues and climate change mitigation, Cogent Eng. 15 (1) (2016) 1–14, doi:10.1080/23311916.2016.1167990.
[48] PAGE (Partnership for Action on Green economy), in: Ghana's Transition to a Green economy: a Stocktaking Report, United Nations Industrial Development Organization, New York, United States of America, 2015, p. 66.
[49] PAGE (Partnership for Action on Green economy) (2019). Green Finance Study in Ghana: Baseline Report.
[50] S. Smit, J.K. Musango, Towards connecting green economy with informal economy in South Africa: a review and way forward, Ecol. Econ. 116 (2015) 154–159.
[51] K. Smith, Monitoring and evaluation of improved biomass cookstove programs for indoor air quality and stove performance: conclusions from the household energy and health project, Energy Sustain. Dev. 11 (2) (2007) 5–18.
[52] P.K. Srivastava, K. Kulshreshtha, C.S. Mohanty, P. Pushpangadan, A. Singh, Stakeholder-based SWOT analysis for successful municipal solid waste management in Lucknow, India, Waste Manag. 25 (5) (2005) 531–537, doi:10.1016/j.wasman.2004.08.010.
[53] G.N. Tiwari, R.K. Mishra, Advanced Renewable Energy Sources, Royal Society of Chemistry, New Delhi, India, 2012.
[54] Transparency International (2020). Corruption perception index 2019. Retrieved from https://www.transparency.org/cpi2019?/news/feature/cpi-2019. (Accessed on 04.02.2020).
[55] UN (United Nations) (2015). Resolution adopted by the General Assembly on 25th September 2015. United Nations, Geneva, Switzerland. Online, https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E. (Accessed on 28.01.2020).
[56] UNDESA (United Nations Department of Economic and Social Affairs), in: A Guidebook to the Green Economy, Issue 1: history, Definitions and a Guide to Recent Publications, UNDESA, United Nations Division for Sustainable Development, New York, United States of America, 2012, p. 60. a.
[57] UNDESA (United Nations Department of Economic and Social Affairs), in: A Guidebook to Green Economy, Issue 2: Exploring Green Economy Principles., UNDESAUnited Nations Division for Sustainable Development, New York, United States of America, 2012, p. 62. b.
[58] UNEP (United Nations Environment Programme), in: Green Economy Reports: a Preview, UNEP, Nairobi, Kenya, 2010, pp. 4–5.
[59] UNEP (United Nations Environment Programme), in: Bio-trade – a Catalyst for Transitioning to a Green Economy in Namibia, UNEP, Nairobi, Kenya, 2012, p. 15.
[60] UNEP (United Nations Environment Programme) (2014). Green Economy Assessment Report – Kenya. UNEP, Nairobi, Kenya. Available online: https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/KenyaGEassessment_UNEP.pdf. (Accessed on 05.02.2020).
[61] UNEP (United Nations Environmental Programme) (2015). Green Economy Assessment Report, Ghana, Accra. https://www.greengrowthknowledge.org/research/green-economy-assessment-report-ghana. (Assessed on 22.10.2020).
[62] UNEP, 2011 a. Towards a Green economy: pathways to sustainable development and poverty eradication. 10.1063/1.3159605.

[63] UN-ESCAP, ADB and UNEP (2010). Green growth, resources and resilience – environmental sustainability in Asia and the Pacific (preview version). United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP), Asian Development Bank (ADB), and United Nations Environment Programme (UNEP), New York, United States of America.
[64] USAID (United States Agency for International Development) (2017). Greenhouse gas emissions in Ghana, USAID Factsheet. USAID, Washington D.C., United States of America. https://www.climatelinks.org/sites/default/files/asset/document/GHG%20Emissions%20Factsheet%20Ghana_6-17-16_edited_rev08-18-2016.pdf. (Accessed on 05.02.2020)
[65] Q. Wang, R. Li, Impact of cheaper oil on economic system and climate change: a SWOT analysis, Renew. Sustain. Energy Rev. 54 (66) (2016) 925–931, doi:10.1016/j.rser.2015.10.087.
[66] C.A. Wongnaa, S. Babu, Building resilience to shocks of climate change in Ghana's cocoa production and its effect on productivity and incomes, Technol. Soc. (2020) 101288.
[67] World Bank, in: Inclusive Green Growth: the Pathway to Sustainable Development, The World Bank, Washington D.C, 2012, p. 171.
[68] World Investment Report (2019). Special economic zone. Retrieved from https://unctad.org/en/PublicationChapters/WIR2019_CH2.pdf. (Accessed on 04.02.2020).
[69] World Resources Institute (WRI)A Compilation of Green Economy Policies, Programmes and Initiatives from Around the World, WRI, Washington D.C., United States of America, 2011.
[70] L. Würtenberger, I.G. Bunzeck, X. van Tilburg, Initiatives Related to Climate Change in Ghana, Energy Research Centre of the Netherlands ECN, Petten, Netherlands, 2011.
[71] E. Yeboah, D. Shaw, Customary land tenure practices in ghana: examining the relationship with land-use planning delivery, Int. Dev. Plann. Rev. 35 (1) (2013) 21–39 2013, doi:10.3828/idpr.2013.3.
[72] The annual public dept report for the 2020 financial year. Retrieved from https://www.mofep.gov.gh/sites/default/files/reports/economic/2020-Annual-Public-Debt-Report.pdf.